Ontario Association of Architects

TEUI Calculator, a Web-based Application: Request for Quotations

The Sustainable Built Environment Committee (SBEC) of the Ontario Association of Architects is hereby requesting that OAA Council review and consider a request to fund a project of SBEC called the 'TEUI' Calculator - a web-based app for performance evaluation of existing Part 9 (and Part 3) Buildings. SBEC has authored this request for quotations (RFQ) to solicit responses from digital web app developers, in order for SBEC to subsequently evaluate and fund the web-app project. There are two parts to this proposal that should be read together, 1. The development of the app codebase and 2. The development of the graphic design for the GUI and printable 'report card' it produces. The proponent(s) will be responsible for coordination between coding and graphics aspects of the project.

The reason for producing such a tool is to serve a need identified by architects to produce an energy-use intensity rating for constructed projects of any scale, but notably for part 9 buildings where an energy model is often not required or performed. This need was further highlighted on review of the most recent OAA awards, which for the first time mandated submission of an EUI rating. For many architects, this was something they were calculating for the first time, and the draft tool that one SBEC member has created at http://teui.ca (domain was registered and paid for by a SBEC member and is publicly accessible, and will be transferred to the OAA as 'owner' at project completion. The domain is currently re-directing to a sandbox development site at: https://www.andythomson.ca/portfolio/2019-008-teui-calculator-kwh-m2yr/ but this can be changed at the award of the TEUI Calculator contract) was well appreciated and utilized by OAA members in order to benchmark their submissions with.

The purpose of this RFQ is to request quotations for a web-based *improvement* of this application with an enhanced graphical interface (GUI) and that can produce a one-time, downloadable or otherwise exportable 'report card' in PDF format for building-related energy performance for use ***only*** by licensed members of the OAA. There would be no storage of the data submitted, and so the OAA would not be in a position where it would require to safeguard user data. There would be no charge for the member use of the service. There is a maintenance clause in the RFQ, but the hosting domain site has been registered and prepaid for a 5-year term, at which point the program and domain will expire unless it is renewed (at a cost of less than $100 which the OAA will assume costs for).

The RFQ requirements are listed below. There is a Graphic Design component of this project that shall be quoted separately. ***Note to RWDI only:*** *It should be noted that the Energy Compass tool (https://energycompass.design/) may also be modified in the case that its developers wish to to respond to the requirements of this RFQ.*

a. TIMELINE
This RFQ is proposed to be issued June 15th, 2020. RFQ responses are required by **Friday, July 31 at 12pm (noon) - submissions should be by email to Adam Tracey** AdamT@oaa.on.ca**.** The 'Project Start' will be the first week of August, 2020. Questions in the interim can be posted in the comments section of the post located at the following URL and will be ***visible to all proponents: http://teui.ca***

The awarded party will be announced by email to all respondents on Monday July 20, 2020.

Milestones referenced below number 1-8.

1. On the Project Start, The successful respondent will be given access by the OAA to the website (ftps) hosted by dreamhost.com. The respondent may utilize any server-side resources provided and hosted by Dreamhost.
2. Respondent will be (alone or in partnership with a graphic designer) produce Draft 1 of 3 of the Graphic Design Concept and present to the OAA.
3. Two weeks after the project start: A functional website with basic charts, a form with default data, ability to enter data dynamically and obtain the calculated results in the form of chart shall be demonstrated to the project team.
4. Respondent will present Draft 2 of 3 of the Graphic Design Concept to the OAA, integrating feedback and elements from presentations 2 & 3.
5. Four weeks after the project starts: A complete website with all the charts, animations, responsive on smaller devices, email and PDF file print functionality and all the other features from the previous milestone with Graphic Design Concept 2 shall be presented to the OAA.
6. Respondent will present Final Draft 3 of 3 of the Graphic Design Concept.
7. Six weeks after the project starts: integration of basic analytics and bug fixes reported after first and previous milestones and coordination with Graphic Design Concept 3 shall be presented to the OAA.
8. Deliverables to be handed off to the OAA (ART lead w. SBEC member support).

B. RESPONSES
All respondents must address each section noted here from A-G of the RFQ in a PDF, Letter-sized format. Submissions should be limited to 10 pages.

C. ABOUT YOUR FIRM/INDIVIDUAL/THE PROPONENT
Please list in paragraph format a brief Statement of Qualifications, followed by at least three examples that can be demonstrated online that use interfaces/methods similar to those required for this project. Respondents should also provide references for these projects that can be followed up with if respondents are short-

listed for consideration. Respondents will be notified and permission requested to followup with references prior to the OAA awarding the project.

1. URI Sample #1
2. URI Sample #2
3. URI Sample #3

List contact information for references noted above:

1. Contact 1
2. Contact 2
3. Contact 3

D. PROJECT SCOPE

Please refer to scope items and referenced attached documents enumerated below:

1. To design a web app to be run on https://teui.ca in which users can calculate TEUI/TEDI/GHGI in realtime and visualize the data in the form of different charts and graphs as shown in the PDF file: OAA TEUI SPEC
2. An approach that uses D3/Javascript will be given preference.
3. The website when open for the first time will have default values entered in its form and the graph/charts will be showing the default values as mentioned in the file: OAA TEUI SPEC
4. The form will open from the left side by clicking a drawer icon and then user will be able to enter the data. The details of the fields inside the form are mentioned in OAA TEUI SPEC file.
5. The design of the website should take inspiration from Material Design and should be simple, and intuitive.
6. Once the user enters the data in the form and graphs are dynamically re-generated ,the home page should have three buttons: Print and Email - user submitted data will not be saved on the website to avoid the OAA becoming responsible for data safeguards. Clicking on them should generate a PDF file of the visualizations and should either Download or Email to the user, at which point data is transferred to the Architect's ownership.
7. At least 3 rounds of coordination with the graphic designer should be planned for, and close parity between the finished product and the graphic design spec will be expected.

E. Resources For The Project

There are three files we will be using as Project Specifications. First is the OAA TEUI SPEC which has the explanation about the design and implementation of the website. Second is Sections H-J of this document, which acts as a background

paper providing with the aims and objectives of the projects. And, the third is an GoogleDocs spreadsheet which provides with the formulae and calculations for the website. Respondents should satisfy themselves of any questions in the RFI period between June 15, 2020 and July 1, 2020 by posting in the comments area of the http://teui.ca website.

Some samples of the look and feel we are after:

1. https://www.dreamstime.com/stock-photography-pyramid-chart-colorful-useful-infographics-presentations-image36086092
2. https://www.dreamstime.com/industry-fourth-industrial-revolution-industrie-colorful-pyramid-chart-useful-infographics-presentations-image119325014
3. https://www.canstockphoto.com/house-energy-efficiency-infographic-55009300.html
4. https://observablehq.com/@d3/gallery

Note: D3 Graphics should dynamically adjust in realtime with changing input to user-defined parameters.

F. Deliverables

1. Functional, responsive (mobile devices/tablets, etc) Website
2. Code Base with Readme file
3. Production Deployment
4. Breakout hourly rate for service, maintenance & ongoing support

G. Cost

Total Project Cost to be presented in ***Canadian Dollars: $0.00 (format)***

Note any/all applicable taxes extra to this cost.

Schedule of Payments:

1. 10% deposit / down payment
2. 25% after 1st report submission in 2 weeks
3. 55% when product is deployed with acceptance testing
4. 10% holdback released on successful, bug-free deployment of the site

H. Background Information: WHAT IS THE TEUI PROJECT?
The SBEC of the OAA, over the course of the past several years, has discussed at length the necessity for improved benchmarking of building performance in the province.

To these ends, the OAA has directly supported and funded a number of projects, most notably the Energy Compass initiative (https://energycompass.design/about/), as a benchmarking tool not dissimilar to BC's Building Pathfinder project here: http://www.buildingpathfinder.com/. The Toronto 2030 District is also an OAA-funded initiative that seeks to provide building energy and GHG Intensity ratings at the urban block and district scale: https://www.toronto2030platform.ca/

The OAA has recently submitted comments requested by the province on the Climate Action and Environmental Plans, that included (among others) the position to;

- *Create mandatory building energy standards with related monitoring. As a regulator with a mandate from the Province to regulate and govern the practice of architecture in service and protection of the public interest, the OAA is well-positioned to help bring attention to this issue.* [3]

To this end, SBEC discussed that while EnergyCompass metrics are essential for the Part 3, larger buildings, there remain millions of square metres of Part 9 and residential buildings in the province that have no formal energy benchmarking standards. To that end, SBEC members agreed that some form of similar energy standard and benchmarking using the standardized metrics of TEUI, TEDI and GHGI should be valuable to both to the profession and the public, as similar standards have been well implemented in British Columbia with the approach. An SBEC member subsequently undertook a side project to test a number of different web-based, open-source methods for calculating TEUI, TEDI and GHGI as is explained in greater detail further on, and presented this to the SBEC in March of 2019.

This SBEC member was encouraged to further develop these ideas and platforms with en eye towards presenting this project to council in the Fall of 2019, for consideration as a formal project of the OAA.

Canada committed to meet the Paris climate targets designed to limit climate change to 1.5ºC, but many individuals, professionals, and municipal officials are in the dark about the performance of their own houses, in objective terms. Below is a summary of Canada's international commitments:

CANADA	Summary of pledges and targets	
PARIS AGREEMENT	Ratified	Yes
	2030 unconditional target(s)	30% below 2005 by 2030 [7-14% below 1990 by 2030 excl. LULUCF] [20-25% below 2010 by 2030 excl. LULUCF]
	Coverage	Economy wide, incl. LULUCF
	LULUCF	Will use LULUCF accounting based on the reference level approach to meet its target
COPENHAGEN ACCORD	2020 target(s)	17% below 2005 by 2020 [4-7% above 1990 by 2020 excl. LULUCF] [7-10% below 2010 by 2020 excl. LULUCF]
	Condition(s)	None
KYOTO PROTOCOL (KP)	Member of KP CP1 (2008–2012)	Withdrawn
	Member of KP CP2 (2013–2020)	No
	KP CP1 target (below base year)	6% below 1990
	KP CP2 target (below base year)	None
LONG-TERM GOAL(S)	Long-term goal(s)	80% net emission reductions below 2005 levels by 2050

Buildings and construction represent as much as 40% of Canada's total CO2e, but myriad competing proprietary energy standards has led to a confusing system of often proprietary ratings and performance targets, such as LEED, Passive House, Build Green, Build Smart, R2000, NetZero, Energy Star, BREEAM, Living Buildings Challenge, WELL, Active House, Green Globes, Energuide, NovoClimat, and many more.

The TEUI projects aims to simplify the understanding of objective, measurable performance values by representing energy and greenhouse gas emissions in three simple and absolute terms, as a function of building area over the course of a year. The values are as relevant when applied to a 20 storey office tower as it is to a single family residence, as a measure of energy and carbon intensity is connected to a representative ***square metre*** of any building.

As the 1. TEUI, 2. TEDI and 3. GHGI ratings have gained traction in engineering and architectural parlance, we have aimed to make this data visually obvious with simple input from a year's worth of energy bills. We feel the first step must be to see and understand the benchmark data, and then to act. The SBEC of the Ontario Association of Architects has been promoting the Provincial and Federal adoption of **mandatory** Energy Ratings using these measures for **all buildings** [3].

But what would such ratings look like?

1. TEUI = TOTAL ENERGY USE INTENSITY
The sum of all energy used by a building on site (i.e. Electricity, natural gas, district heat), minus all renewable energy generated on site, divided by the Floor Area. (NET)

Units: **kWh/m²*yr**
Typical Range: 300 (terrible) to 100 (good)

2. TEDI = THERMAL ENERGY DEMAND INTENSITY
The annual heating load per floor area of a building. This is the amount of heat needed to offset the heat loss through the building envelope and condition the ventilation air and typically includes domestic hot water heating.

Units: **kWh/m²*yr**
Typical Range: 150 (terrible) to 15 (excellent)

Examples of TEDI ratings below

BC Energy Step Code		Toronto Zero Building Emissions Framework	
Step	TEDI Requirement (kWh/m²/year)	Tier	TEDI Requirement (kWh/m²/year)
1	None	1	70
2	45	2	50
3	30	3	30
4	15	4	15

3. GHGI = GREENHOUSE GAS INTENSITY
The sum of all carbon emissions generated by a ***building*** on site, plus carbon emissions generated off site as a function of energy use by type (i.e. Electrical Generation, Natural Gas, Wood, Oil), minus all carbon offsets generated on or off-site (i.e. Bullfrog 'Green Natural Gas'). // refer to ISO 16745-2:2017 (NET) *Note: Not All Regions Equal. QC = 98% GHG Neutral, ON =90% (58% Nuclear).*

Units: **MT/yr ~ or MT/m²*yr**
Typical Range: 10 MT/yr (terrible) to 1 MT/yr (amazing)

There is at present no readily accessible Canadian calculator or method to calculate these impacts however, and this is where SBEC sees an opportunity for the OAA to take a leadership role, by providing not only a tool for calculating these impacts, but a certification that a licensed, insured, professional OAA architect is in a unique position to provide as both a service and a certification on their work. All this requires is a method for determining total GCA Areas, and one year's worth of the energy bills from constructed projects.

Establishing and popularizing this method and approach is a first step in benchmarking existing buildings, and the next step is to target future building performance in these same terms, as a reflection of our National and Provincial commitments to taking action on Climate Change. The OAA could furthermore submit these standardized guidelines to municipalities that could in turn adopt these values and measurements as a standard practice at the issuance of Occupancy Permits and Post Occupancy Review and Reporting (12 months after Occupancy).

For municipalities that have declared climate emergencies, the OAA can offer these services to address existing building stock performance, in order to better address standards and targets for future builds. We imagine this project as consisting of 4 parts;

1. Creating a draft web-based calculator (php/Javascript/D3) for generation of TEUI, TEDI and GHGI metrics, together with a secure back-end database (mySQL) that tracks OAA user ID and Project numbers together with the recorded results (for validation and auditing purposes).
2. Testing and Validating the metrics and methods using industry accepted methods for area and GHG intensity (ISO, Bullfrog, CPA Canada, NRCan)
3. Creating a graphic, digital certification stamp or document to apply towards a completed building (OAA)
4. Promoting this as a service that architects are uniquely qualified to deliver for all classes of buildings (OAA, Municipalities)

It should be noted that Energy and Water use reporting is already a legal requirement in Ontario as per O.Reg 20/17: REPORTING OF ENERGY CONSUMPTION AND WATER USE for all non-public buildings over 50,000sf in Building Area. (per: https://www.ontario.ca/laws/regulation/r17020), although it is mandatory, there is not yet any penalty or fine imposed for non-compliance. Data from this initiative is not readily accessible to the public. The OAA would suggest 'daylighting' this data by making it readily accessible on municipal websites.

The OAA would recommend the expansion of the O.Reg 20/17 to include all buildings, irrespective of area, in public and private sectors, and especially in Post Occupancy review and at the time of a real estate listing for sale. The mandatory disclosure of the energy performance of a given asset, will ultimately preference

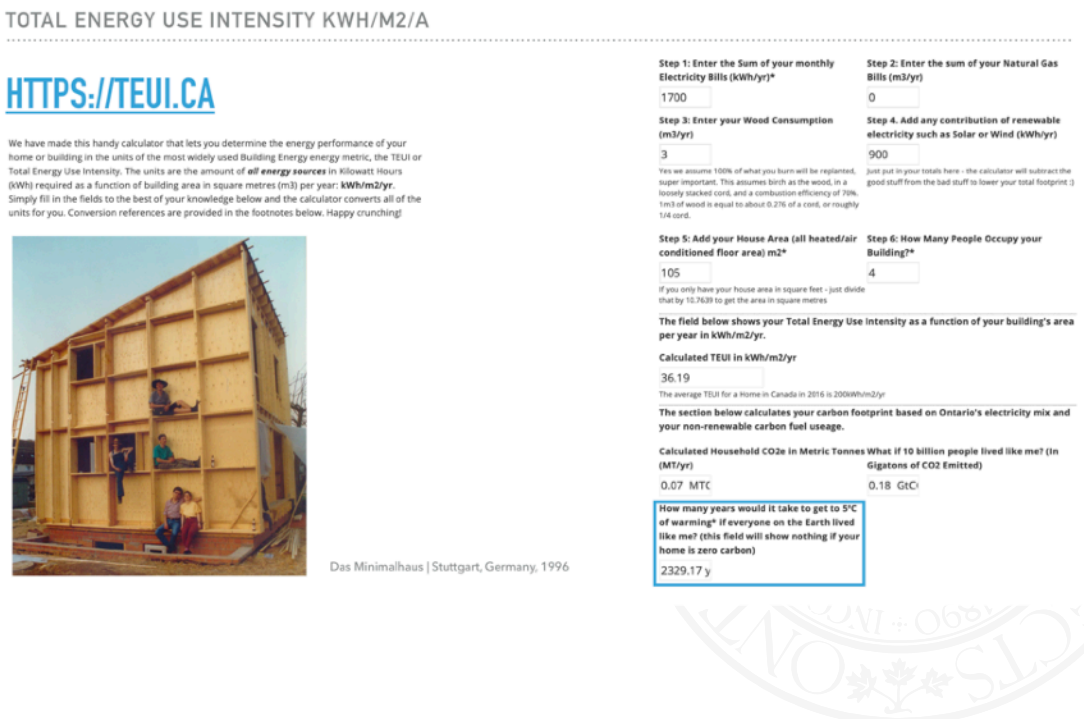
improved building performance considerations at the time of new construction and renovations as there will be a greater awareness of the value of improved performance in the marketplace.

I. Case Studies:

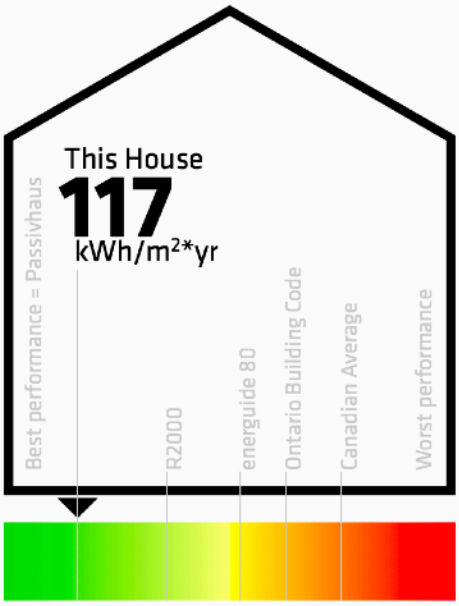
1. An SBEC member has created a draft calculator at http://teui.ca that lets a user determine the energy performance of any home or building in the units of the most widely used Building Energy energy metric, the TEUI or Total Energy Use Intensity. The units are the amount of all energy sources in Kilowatt Hours (kWh) required as a function of building area in square metres per year: kWh/m²*yr. A user simply fills in the fields using data from your energy bills and the calculator converts all of the units for you.

Conversion references are provided in the footnotes from NRC at http://teui.ca

Below: Slide from OAA Conference Presentation on TEUI calculation as per https://teui.ca



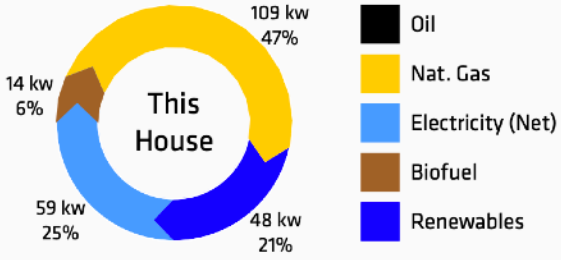
2. A Sample Infographic designed by TAI based loosely on the Energuide for Homes stamp:



one kilowatt hour/m2 = a toaster running all year per every square meter of your home.

TEUI RATING

1. (Total Energy Use Intensity) = 125kWh/m²*yr



2. GHGI (Greenhouse Gas Intensity) = 2MT

Canadian Average	6.35MT CO2e
Canadian 2030 Target	1.00 MT CO2e
Canadian 2050 Target	0.00 MT CO2e

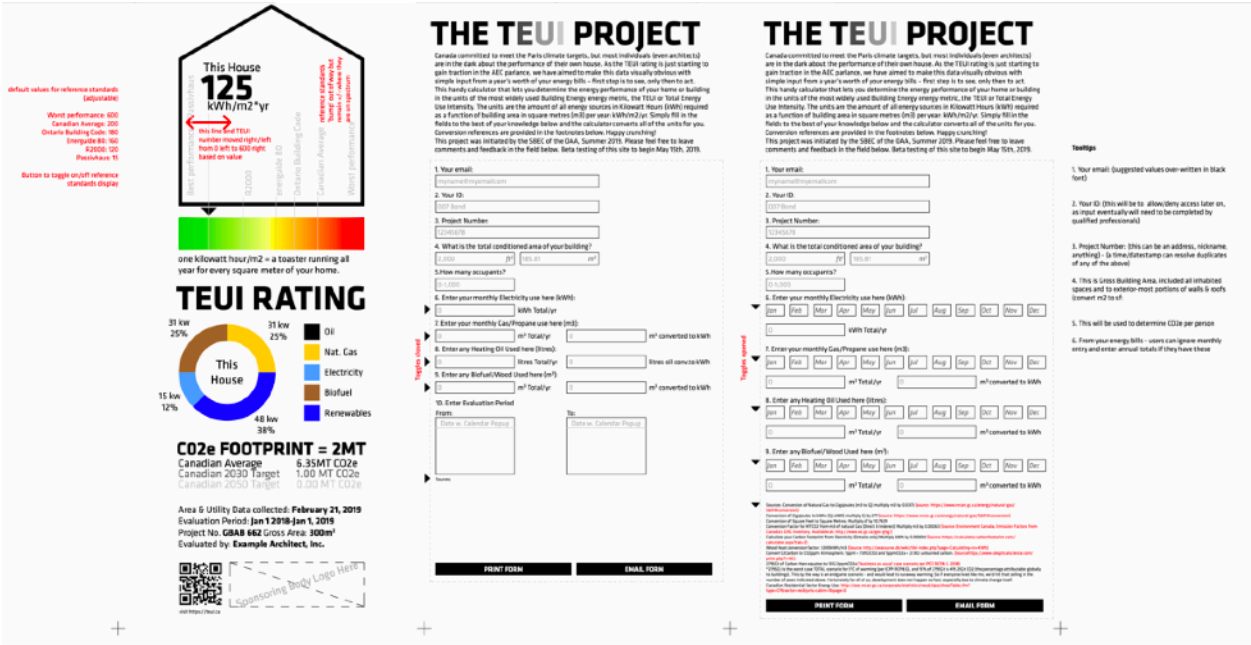
3. TEDI (Thermal Energy Demand Intensity) = 62kWh/m²*yr

Area & Utility Data collected: **February 21, 2019**
Evaluation Period: **Jan 1 2018-Jan 1, 2019**
Project No. **GBAB 662** Gross Area: **300m²**
Evaluated by: **Example Architect, Inc.**

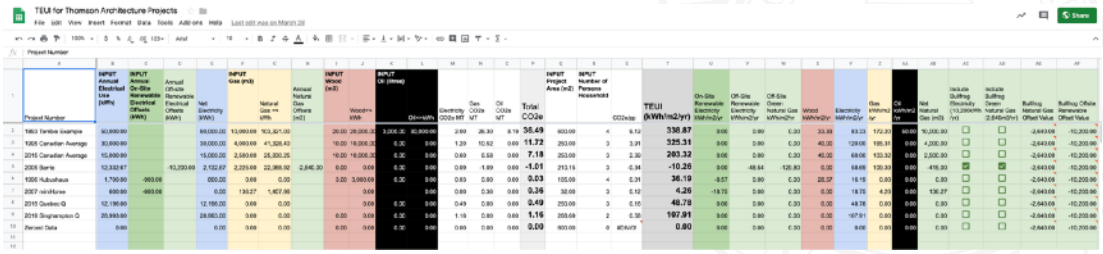
visit https://teui.ca

Sponsoring Body Logo Here

3. An SBEC member's Open Spreadsheet Method and Full Specification for continued software development, refer to appended PDF document for a larger view:

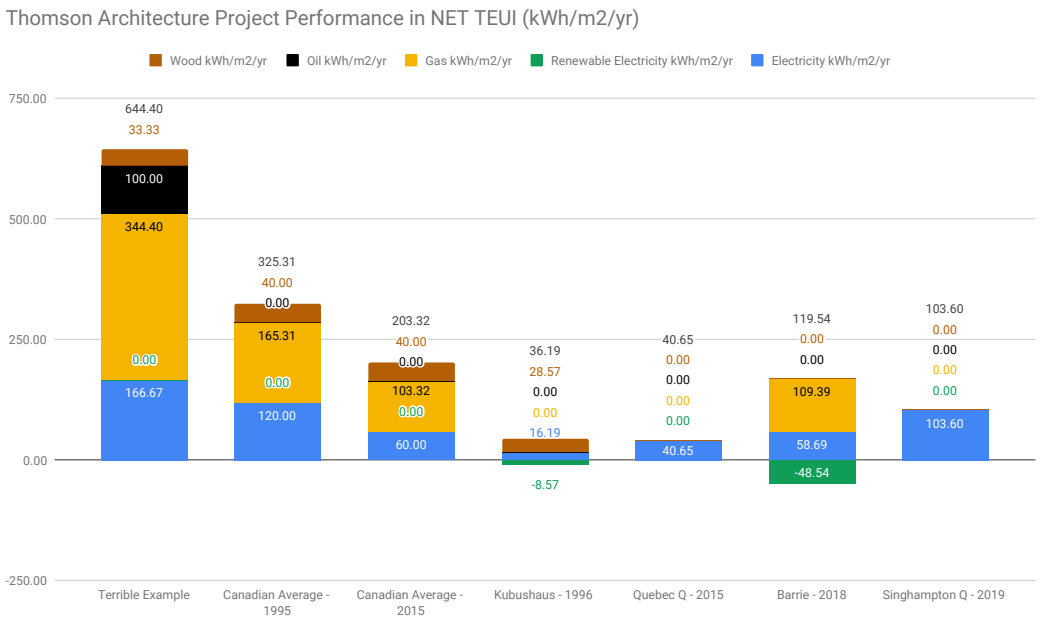


Google Docs Variation of the TEUI Calculator, NET TEUI input fields below:

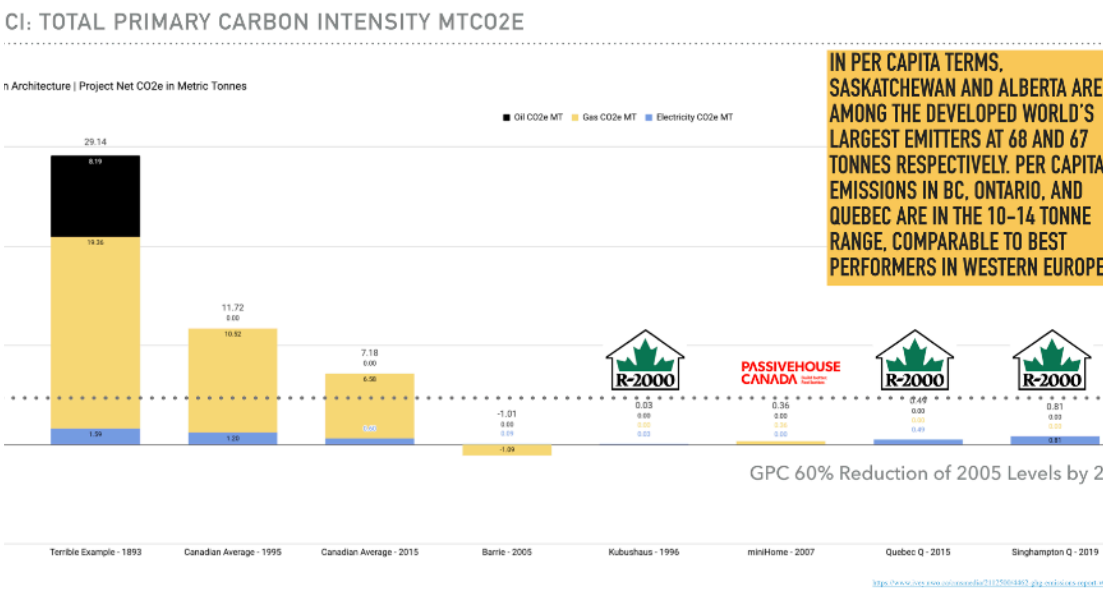


The Demonstrator Spreadsheet can be found at this URL: https://docs.google.com/spreadsheets/d/1WNxjKc1zoxn14F31dHHr6IACEwmloON1CzaBMR7Adgw/edit?usp=sharing

Google Docs version of the TEUI project showing NET TEUI below:



Google Docs version of the TEUI project showing GHGI below:



J. Terms

Respondents agree to the terms below.

1. Confidentiality, OAA privacy policy
2. Ownership & Copyright (author retains, but grants unlimited use to OAA) & right to modify by others
3. User terms to be added by OAA after project completion and beta testing.

end